

Amendments to the Claims

1 1. (previously presented) A shadow rendering method, the method comprising
2 the steps of:
3 providing observer data of a simulated multi-dimensional scene;
4 providing lighting data associated with a plurality of simulated light sources arranged
5 to illuminate said scene, said lighting data including light image data;
6 for each of said plurality of light sources, comparing at least a portion of said
7 observer data with at least a portion of said lighting data to determine if a modeled point
8 within said scene is illuminated by said light source and storing at least a portion of said light
9 image data associated with said point and said light source in a light accumulation buffer;
10 and then
11 combining at least a portion of said light accumulation buffer with said observer data;
12 and
13 outputting resulting image data.

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15 Claims 2-48 (cancelled)

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17 49. (previously presented) The method as recited in Claim 1, wherein said
18 observer data includes observed color data and observed depth data associated with a
19 plurality of modeled polygons within said scene as rendered from an observer's perspective.

20 50. (previously presented) The method as recited in Claim 49, wherein said
21 plurality of modeled polygons within said scene are associated with at least one pixel, such
22 that said observed color data includes an observed red-green-blue value for said pixel and
23 said observed depth data includes an observed z-buffer value for said pixel.

24 51. (previously presented) The method as recited in Claim 49, wherein said
25 lighting data includes source color data associated with at least one of said light sources and
26 source depth data associated with said plurality of modeled polygons within said scene as
27 rendered from a plurality of different light source's perspectives.

28 52. (previously presented) The method as recited in Claim 51, wherein said
29 plurality of modeled polygons within said scene are associated with at least one pixel, such
30 that said source color data includes a source red-green-blue value for said pixel and said
31 source depth data includes a source z-buffer value for said pixel.

32 53. (previously presented) The method as recited in Claim 51, wherein the step of
33 comparing at least a portion of said observer data with at least a portion of said lighting data
34 to determine if a modeled point within said scene is illuminated by said light source further
35 includes comparing at least a portion of said observed depth data with at least a portion of
36 said source depth data to determine if said modeled point is illuminated by said light source.

37 54. (previously presented) The method as recited in Claim 53, wherein the step of
38 comparing at least a portion of said observed depth data with at least a portion of said source
39 depth data to determine if said modeled point is illuminated by said light source further
40 includes converting at least a portion of said observed depth data from said observer's

perspective to at least one of said plurality of different light source's perspectives, before
comparing said observed depth data with said source depth data.

55. (previously presented) The method as recited in Claim 54, wherein the step of
converting at least a portion of said observed depth data from said observer's perspective to
at least one of said plurality of different light source's perspectives further includes using a
precalculated matrix transformation look-up table for at least one of said plurality of light
sources, when said light source has a fixed perspective of said scene.

56. (previously presented) The method as recited in Claim 49, wherein at least a
portion of said source color data is selectively controlled source color data that can be
changed over a period of time during which at least the step of outputting the resulting image
data is repeated a plurality of times.

57. (previously presented) The method as recited in Claim 56, wherein said
controlled source color data includes data selected from a set comprising motion picture data,
video data, animation data, and computer graphics data.

58. (previously presented) An arrangement configured to render shadows in a
simulated multidimensional scene, the arrangement comprising:

an output to a display screen configured to display image data;
memory for storing data including observer data associated with a simulated multi-
dimensional scene, and lighting data associated with a plurality of simulated light sources
arranged to illuminate said scene, said lighting data including light image data, said memory
further including a light accumulation buffer portion and a frame buffer portion;

at least one processor coupled to said memory and said output and operatively configured to, for each of said plurality of light sources, compare at least a portion of said observer data with at least a portion of said lighting data to determine if a modeled point within said scene is illuminated by said light source and storing at least a portion of said light image data associated with said point and said light source in said light accumulation buffer, then combining at least a portion of said light accumulation buffer with said observer data, and storing resulting image data in said frame buffer, and outputting at least a portion of said image data in said frame buffer via said output.

59. (previously presented) The arrangement as recited in Claim 58, wherein said observer data includes observed color data and observed depth data associated with a plurality of modeled polygons within said scene as rendered from an observer's perspective.

60. (previously presented) The arrangement as recited in Claim 59, wherein said plurality of modeled polygons within said scene are associated with at least one pixel on said display screen, such that said observed color data includes an observed red-green-blue value for said pixel and said observed depth data includes a observed z-buffer value for said pixel.

61. (previously presented) The arrangement as recited in Claim 59, wherein said lighting data includes source color data associated with at least one of said light sources and source depth data associated with said plurality of modeled polygons within said scene as rendered from a plurality of different light source's perspectives.

62. (previously presented) The arrangement as recited in Claim 61, wherein said plurality of modeled polygons within said scene are associated with at least one pixel, such

83 that said source color data includes a source red-green-blue value for said pixel and said
84 source depth data includes a source z-buffer value for said pixel.

85 63. (previously presented) The arrangement as recited in Claim 61, wherein said
86 processor is further configured to compare at least a portion of said observed depth data with
87 at least a portion of said source depth data to determine if said modeled point is illuminated
88 by said light source.

89 64. (previously presented) The arrangement as recited in Claim 63, wherein said
90 processor is further configured to convert at least a portion of said observed depth data from
91 said observer's perspective to at least one of said plurality of different light source's
92 perspectives, before comparing said observed depth data with said source depth data.

93 65. (previously presented) The arrangement as recited in Claim 64, wherein said
94 memory further includes at least one precalculated matrix transformation table associated
95 with at least one of said plurality of light sources, and said processor is further configured to
96 use said precalculated matrix transformation look-up table when said light source is
97 simulated as having a fixed perspective of said scene.

98 66. (previously presented) The arrangement as recited in Claim 61, wherein said
99 processor is further configured to selectively control at least a portion of said source color
100 data over a period of time.

101 67. (previously presented) The arrangement as recited in Claim 66, wherein said
102 controlled source color data includes data selected from a set comprising motion picture data,
103 video data, animation data, and computer graphics data.

104 68. (previously presented) A computer-readable medium carrying at least one set
105 of computer instructions configured to cause a computer to operatively simulate light falling
106 on a modeled object in a computer generated multi-dimensional graphics simulation by
107 performing operations comprising:

108 a) rendering an observer view of at least a portion of a spatially modeled object
109 as a plurality of observed depth values and observed image values;

110 b) rendering a source view of at least a portion of said modeled object as a
111 plurality of source depth values and a plurality of source image values;

112 c) transforming at least a portion of said observed depth values to said source
113 view;

114 d) modifying at least one image accumulation value with one of said observed
115 image values if said corresponding transformed observer value is equal to a comparable one
116 of said source depth values;

117 e) multiplying said one of said observed image values by said at least one image
118 accumulation value to produce at least one pixel value; and

119 f) output said pixel value to a computer screen.

120 69. (previously presented) The computer-readable medium as recited in Claim 68,
121 further configured to cause tcomputer to perform the further step of:

122 g) following step d), repeating steps b) through d) for at least one additional
123 source view.

124 70. (previously presented) The computer-readable medium as recited in Claim 69,
125 further configured to cause the computer to perform the further steps of:

126 h) repeating steps a) through g) a frame rate; and

127 wherein step f) further includes sequentially outputting a plurality of pixels as frames
128 of data to said computer screen at said frame rate, and said step of rendering said source view
129 further includes changing at least one of said source image values between said subsequent
130 frames of data.

131 71. (previously presented) The computer-readable medium as recited in Claim 70
132 wherein at least a portion of said source image values represent color data selected from a set
133 comprising motion picture data, video data, animation data, and computer graphics data.

134 72. (previously presented) The computer-readable medium as recited in Claim 70,
135 wherein step c) further includes transforming at least a portion of said observed depth values
136 from an observer coordinate system to a corresponding source coordinate system.

137 73. (previously presented) The computer-readable medium as recited in Claim 72,
138 wherein the step of transforming at least a portion of said observed depth values from an
139 observer coordinate system to a corresponding source coordinate system further includes
140 using a precalculated transformation table to transform directly from said observer coordinate
141 system to said corresponding source coordinate system.

142 74. (currently amended) A computer-readable medium carrying at least one set of
143 computer instructions configured to cause at least one processor to operatively render
144 simulated shadows in a multi-dimensional simulated scene by performing the steps of:

145 providing observer data of a simulated multi-dimensional scene;
146 providing lighting data associated with a plurality of simulated light sources arranged
147 to illuminate said scene, said lighting data including light image data;
148 for each of said plurality of light sources, comparing at least a portion of said
149 observer data with at least a portion of said lighting data to determine if a modeled point
150 within said scene is illuminated by said light source and storing at least a portion of said light
151 image data associated with said point and said light source in a light accumulation buffer;
152 and then
153 combining at least a portion of said light accumulation buffer with said observer data;
154 and
155 outputting resulting image data to a computer screen.

156 75. (previously presented) The computer-readable medium as recited in Claim 74,
157 wherein said observer data includes observed color data and observed depth data associated
158 with a plurality of modeled polygons within said scene as rendered from an observer's
159 perspective.

160 76. (previously presented) The computer-readable medium as recited in Claim 75,
161 wherein said plurality of modeled polygons within said scene are associated with at least one
162 pixel, such that said observed color data includes an observed red-green-blue value for said
163 pixel and said observed depth data includes a observed z-buffer value for said pixel.

164 77. (previously presented) The computer-readable medium as recited in Claim 75,
165 wherein said lighting data includes source color data associated with at least one of said light

sources and source depth data associated with said plurality of modeled polygons within said scene as rendered from a plurality of different light source's perspectives.

78. (currently amended) The computer-readable medium as recited in Claim 75, wherein said plurality of modeled polygons within said scene are associated with at least one pixel ~~on said computer screen~~, such that said source color data includes a source red-green-blue value for said pixel and said source depth data includes a source z-buffer value for said pixel.

79. (previously presented) The computer-readable medium as recited in Claim 77, where in the step of comparing at least a portion of said observer data with at least a portion of said lighting data to determine if a modeled point within said scene is illuminated by said light source further includes comparing at least a portion of said observed depth data with at least a portion of said source depth data to determine if said modeled point is illuminated by said light source.

80. (previously presented) The computer-readable medium recited in Claim 79, where in the step of comparing at least a portion of said observed depth data with at least a portion of said source depth data to determine if said modeled point is illuminated by said light source further includes converting at least a portion of said observed depth data from said observer's perspective to at least one of said plurality of different light source's perspectives, before comparing said observed depth data with said source depth data.

81. (previously presented) The computer-readable medium as recited in Claim 80, wherein the step of converting at least a portion of said observed depth data from said

observer's perspective to at least one of said plurality of different light source's perspectives further includes using a precalculated matrix transformation look-up table for at least one of said plurality of light sources, when said light source has a fixed perspective of said scene.

82. (currently amended) The computer-readable medium as recited in Claim 77, wherein at least a portion of said source color data is selectively controlled source color data that can be changed over a period of time during which at least the step of outputting the resulting image data to ~~said computer screen~~ a display device is repeated a plurality of times.

83. (previously presented) The computer-readable medium as recited in Claim 82, wherein said controlled source color data includes data selected from a set comprising motion picture data, video data, animation data, and computer graphics data.

84. (new) A computer circuit for processing computer graphics data coupled to at least one processor to operatively render simulated shadows in a multi-dimensional simulated scene by performing steps comprising:

- a) receiving observer data of a simulated multi-dimensional scene;
- b) receiving lighting data associated with a plurality of simulated light sources arranged to illuminate said scene, said lighting data including light image data;
- c) for each of said plurality of light sources, comparing at least a portion of said observer data with at least a portion of said lighting data to determine if a modeled point within said scene is illuminated by said light source and storing at least a portion of said light image data associated with said point and said light source;

d) combining at least a portion of said stored light image data with said observer data;

and

e) transmitting resulting image data to be displayed on a computer screen.

85. (new) The computer circuit recited in claim 84, wherein said observer data includes observed color data and observed depth data associated with a plurality of modeled polygons within said scene as rendered from an observer's perspective.

86. (new) The computer circuit recited in claim 85, wherein said plurality of modeled polygons within said scene are associated with at least one pixel, such that said observed color data includes an observed red-green-blue value for said pixel and said observed depth data includes an observed z-buffer value for said pixel.

87. (new) The computer circuit recited in claim 85, wherein said lighting data includes source color data associated with at least one of said light sources and source depth data associated with said plurality of modeled polygons within said scene as rendered from a plurality of different light source's perspectives.

88. (new) The computer circuit recited in claim 85, wherein said plurality of modeled polygons within said scene are associated with at least one pixel on said computer screen, such that said source color data includes a source red-green-blue value for said pixel and said source depth data includes a source z-buffer value for said pixel.

89. (new) The computer circuit recited in claim 87, where in the step of comparing at least a portion of said observer data with at least a portion of said lighting data to determine if a modeled point within said scene is illuminated by said light source further

228 includes comparing at least a portion of said observed depth data with at least a portion of
229 said source depth data to determine if said modeled point is illuminated by said light source.

230 90. (new) The computer circuit recited in claim 89, where in the step of
231 comparing at least a portion of said observed depth data with at least a portion of said source
232 depth data to determine if said modeled point is illuminated by said light source further
233 includes converting at least a portion of said observed depth data from said observer's
234 perspective to at least one of said plurality of different light source's perspectives, before
235 comparing said observed depth data with said source depth data.

236 91. (new) The computer circuit recited in claim 90, wherein the step of converting
237 at least a portion of said observed depth data from said observer's perspective to at least one
238 of said plurality of different light source's perspectives further includes using a look-up table
239 containing predetermined transformation values for at least one of said plurality of light
240 sources, when said light source has a fixed perspective of said scene.

241 92. (new) The computer circuit recited in claim 87, wherein at least a portion of
242 said source color data is selectively controlled source color data that can be changed over a
243 period of time during which at least the step of transmitting the resulting image data to said
244 computer screen is repeated a plurality of times.

245 93. (new) The computer circuit recited in claim 92, wherein said controlled source
246 color data includes data selected from stored motion picture data.

247 94. (new) The computer circuit recited in claim 92, wherein said controlled source
248 color data includes data selected from stored computer animation data.

249 95. (new) The computer circuit recited in claim 92, wherein said controlled source
250 color data includes data selected from stored video data.

251 96. (new) The computer circuit recited in claim 92, wherein said controlled source
252 color data includes data selected from stored computer graphics sequence data.

253 97. (new) A computer circuit for processing computer graphics data coupled to a
254 computer system to operatively render simulated shadows in a multi-dimensional simulated
255 scene by performing steps comprising:

- 256 a) receiving observer data of a simulated multi-dimensional scene;
257 b) receiving lighting data associated with a plurality of simulated light sources
258 arranged to illuminate said scene, said lighting data including light image data;
259 c) for each of said plurality of light sources, comparing at least a portion of said
260 observer data with at least a portion of said lighting data to determine if a modeled point
261 within said scene is illuminated by said light source and storing at least a portion of said light
262 image data associated with said point and said light source;
263 d) combining at least a portion of said light image data with said observer data; and
264 e) transmitting resulting image data for display on a computer screen.

265 98. (new) The computer circuit recited in claim 97, wherein said observer data
266 includes observed color data and observed depth data associated with a plurality of modeled
267 polygons within said scene as rendered from an observer's perspective.

268 99. (new) The computer circuit recited in claim 98, wherein said plurality of
269 modeled polygons within said scene are associated with at least one pixel, such that said

270. observed color data includes an observed red-green-blue value for said pixel and said
271 observed depth data includes an observed z-buffer value for said pixel.

272 100. (new) The computer circuit recited in claim 98, wherein said lighting data
273 includes source color data associated with at least one of said light sources and source depth
274 data associated with said plurality of modeled polygons within said scene as rendered from a
275 plurality of different light source's perspectives.

276 101. (new) The computer circuit recited in claim 98, wherein said plurality of
277 modeled polygons within said scene are associated with at least one pixel on said computer
278 screen, such that said source color data includes a source red-green-blue value for said pixel
279 and said source depth data includes a source z-buffer value for said pixel.

280 102. (new) The computer circuit recited in claim 100, where in the step of
281 comparing at least a portion of said observer data with at least a portion of said lighting data
282 to determine if a modeled point within said scene is illuminated by said light source further
283 includes comparing at least a portion of said observed depth data with at least a portion of
284 said source depth data to determine if said modeled point is illuminated by said light source.

285 103. (new) The computer circuit recited in claim 102, where in the step of
286 comparing at least a portion of said observed depth data with at least a portion of said source
287 depth data to determine if said modeled point is illuminated by said light source further
288 includes converting at least a portion of said observed depth data from said observer's
289 perspective to at least one of said plurality of different light source's perspectives, before
290 comparing said observed depth data with said source depth data.

291 104. (new) The computer circuit recited in claim 103, wherein the step of
292 converting at least a portion of said observed depth data from said observer's perspective to
293 at least one of said plurality of different light source's perspectives further includes using a
294 look-up table containing predetermined transformation values for at least one of said plurality
295 of light sources, when said light source has a fixed perspective of said scene.

296 105. (new) The computer circuit recited in claim 100, wherein at least a portion of
297 said source color data is selectively controlled source color data that can be changed over a
298 period of time during which at least the step of transmitting the resulting image data to said
299 computer screen is repeated a plurality of times.

300 106. (new) The computer circuit recited in claim 105, wherein said controlled
301 source color data includes data selected from stored motion picture data.

302 107. (new) The computer circuit recited in claim 105, wherein said controlled
303 source color data includes data selected from stored computer animation data.

304 108. (new) The computer circuit recited in claim 105, wherein said controlled
305 source color data includes data selected from stored video data.

306 109. (new) The computer circuit recited in claim 105, wherein said controlled
307 source color data includes data selected from stored computer graphics sequence data.

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